1 Fish indicators

Name of indicator	1.1 Abundance and distribution of juvenile flounder
Type of Indicator	State indicator
Author(s)	Meri Kallasvuo, Eevi Kokkonen & Antti Lappalainen
Description of the indicator	The indicator illustrates the abundance and distribution of juvenile flounders in shallow coastal sandy nursery habitats. Flounder is a fish species, which lives at the northern edge of its distributional range in the northern Baltic Sea (Nissling *et al*. 2002) and, thus, is sensitive to changes in the environment. Therefore, the abundance and distribution of juvenile flounders in shallow sandy habitats can be used as an indicator linked to fish reproduction and environmental status of coastal waters. In the northern Baltic Sea, flounder spawning is strongly determined by salinity (Nissling *et al*. 2002) and occurs in late spring (Florin 2005). After hatching, larvae are pelagic for a few months (Bagge 1981), until they undergo metamorphosis to attain asymmetric body shape and settle to shallow (< 1 m) sandy nursery areas in late summer (Florin *et al*. 2009, Martinsson and Nissling 2011).
Relationship of the indicator to marine biodiversity	The indicator describes the environmental status of coastal habitats i.e. shallow sandy bottoms and the pelagial part of the archipelago during the larval phase. The increase in filamentous algae observed in recent years potentially reduces the quality and quantity of suitable shallow sandy bottoms used as flounder nursery areas (Pihl *et al.* 2005, Wennhage and Pihl 2007, Carl *et al*. 2008). The environmental conditions (and changes) occurring in the pelagial and their effects on larval flounders are still unknown.
Relevance of the indicator to different policy instruments	MSFD descriptor 1 (especially 1.6. Habitat condition): environmental status of the coastal shallow sandy bottoms (juveniles) and the pelagial part of the archipelago area during midsummer (larvae).
Relevance to commission decision criteria and indicator	1.1.1. Distributional range 1.2.1. Population abundance and/or biomass 1.6.1. Condition of the typical species and communities
Method(s) for obtaining indicator values	The abundance and distribution of juvenile flounders in shallow coastal sandy habitats is monitored with beach seine in autumn (young-of-the-year juveniles) or spring (1+ over-wintered juveniles) combined with environmental variable measurements. Indicator is based on average numbers and occurrence of juvenile flounder (≤ 70 mm) in fixed coastal monitoring areas. Data analysis from field inventories to optimize the sampling size and time for future indicator monitoring continues.
Documentation of relationship between indicator and pressure	The habitat requirements of fish are known to be most strict during the early life stages and, thus, the quality and quantity of reproduction habitats lays the basis for fish production (Houde 1989, Urho 2002). This also implies that environmental changes affect fish populations in many cases most heavily during the reproductive phase. A considerable number of fish species in the northern Baltic Sea reproduce in the shallow coastal areas, which are the most heavily exploited parts and also affected by large scale environmental changes. Flounders are naturally not associated with vegetated areas (Florin et al 2009) and avoid vegetation, such as algal mats, if possible (Carl *et al*. 2008). In the Finnish coastal area, flounders also live on the edge of their reproductive range determined by low salinity (5-6 psu) and, therefore, are susceptible to declining salinity (Nissling *et al*. 2002). Thus, main pressures potentially affecting juvenile flounders are eutrophication and climate change. By the time of sampling, juvenile flounders have already been exposed to varying environmental conditions and passed critical periods (pelagic larval stage, metamorphosis, settling, possibly also overwintering).
Geographical relevance of indicator	2. Regional
How Reference Conditions (target values/ thresholds) for the indicator were obtained?	Some baseline data is available from last few decades from Finland (Aro and Sjöblom 1982) and new field data was gathered within MARMONI in Finland still in spring 2014. In spring 2013, data was gathered also in Estonia. Preliminary description of data is shown in figures 1-4. The annual variation appears relatively high.
Method for determining GES	The preliminary GES-target is that the abundance and distribution range of juvenile flounder do not decrease. A more precise target value for GES will be determined later if the indicator will be adopted to use and new data will be available. More data and analysis is needed to understand the causes of annual variation.
References	Aro E. & Sjöblom V. 1982. The abundance of 0-group 1-year-old flounder off the coast of

Finland in 1978-81 according to exploratory fishing with a beach seine. ICES International Council for the Exploration of the Sea, Council Meeting documents, Baltic Fish Committee J:26.

Bagge O. 1981. Demersal fishes. In: Voipio A. (ed.), The Baltic Sea. Elsevier Oceanographic Series 30 ed., Elsevier Scientific Company, Amsterdam, pp. 331-333.

Carl J.D., Sparrevohn C.R., Nicolajsen H. & Støttrup J.G. 2008. Substratum selection by juvenile flounder *Platichthys flesus (L.)*: effect of ephemeral filamentous macroalgae. J Fish Biol 72: 2570-2578.

Florin A. 2005. Flatfishes in the Baltic Sea - a review of biology and fishery with a focus on Swedish conditions. Finfo 2005:14: 1-56.

Florin A., Sundblad G. & Bergström U. 2009. Characterisation of juvenile flatfish habitats in the Baltic Sea. Estuar Coast Shelf Sci 82: 294-300.

Houde E.D. 1989. Subtleties and episodes in the early life of fishes. J Fish Biol 35: 29-38.

Martinsson J. & Nissling A. 2011. Nursery area utilization by turbot (Psetta maxima) and flounder (*Platichthys flesus*) at Gotland, central Baltic Sea. Boreal Env Res 16: 60-70.

Nissling A., Westin L. & Hjerne O. 2002. Reproductive success in relation to salinity for three flatfish species, dab (*Limanda limanda*), plaice (*Pleuronectes platessa*), and flounder (*Pleuronectes flesus*), in the brackish water Baltic Sea. ICES Journal of Marine Science: Journal du Conseil 59: 93-108.

Pihl L., Modin J. & Wennhage H. 2005. Relating plaice (*Pleuronectes platessa*) recruitment to deteriorating habitat quality: effects of macroalgal blooms in coastal nursery grounds. Can J Fish Aquat Sci 62: 1184-1193.

Urho L. 2002. The importance of larvae and nursery areas for fish production. PhD thesis, University of Helsinki and Finnish Game and Fisheries Research Institute: 1-118.

Wennhage H. & Pihl L. 2007. From flatfish to sticklebacks: assemblage structure of epibenthic fauna in relation to macroalgal blooms. Mar Ecol Prog Ser 335: 187-198.

Illustrative material for indicator documentation

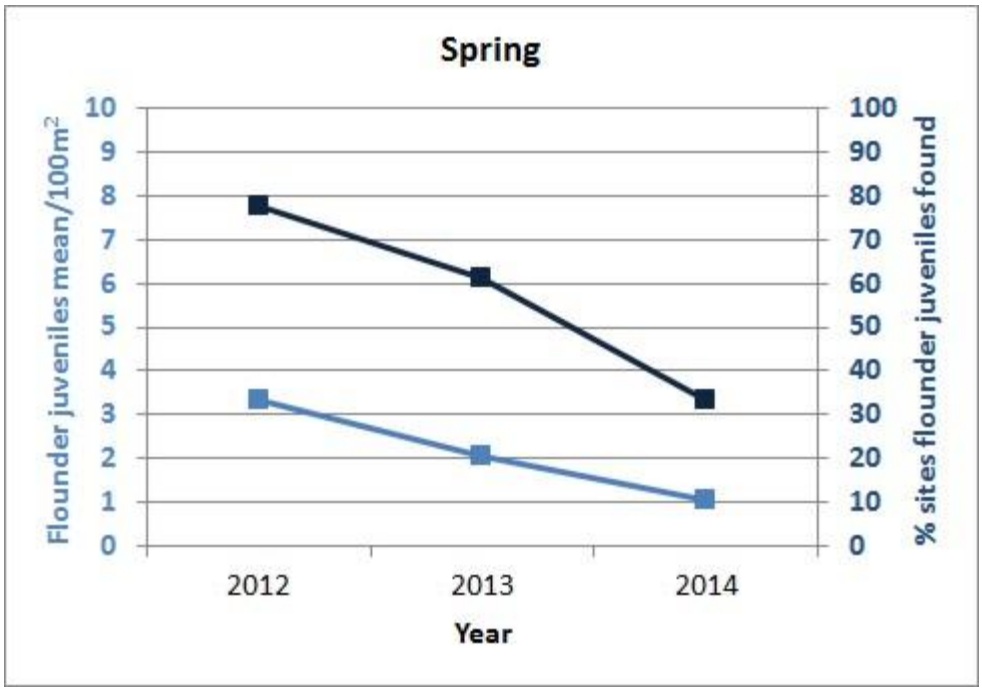

Figure 1. Flounder juveniles abundance and occurrence in the spring. Mean of flounder juveniles in 100 square meters is presented in light blue lines. In calculation minimum haul area was used. Dark blue color describes the percent of sites where flounder juveniles were found. From Finland 18 sites which have been visited every spring are included.

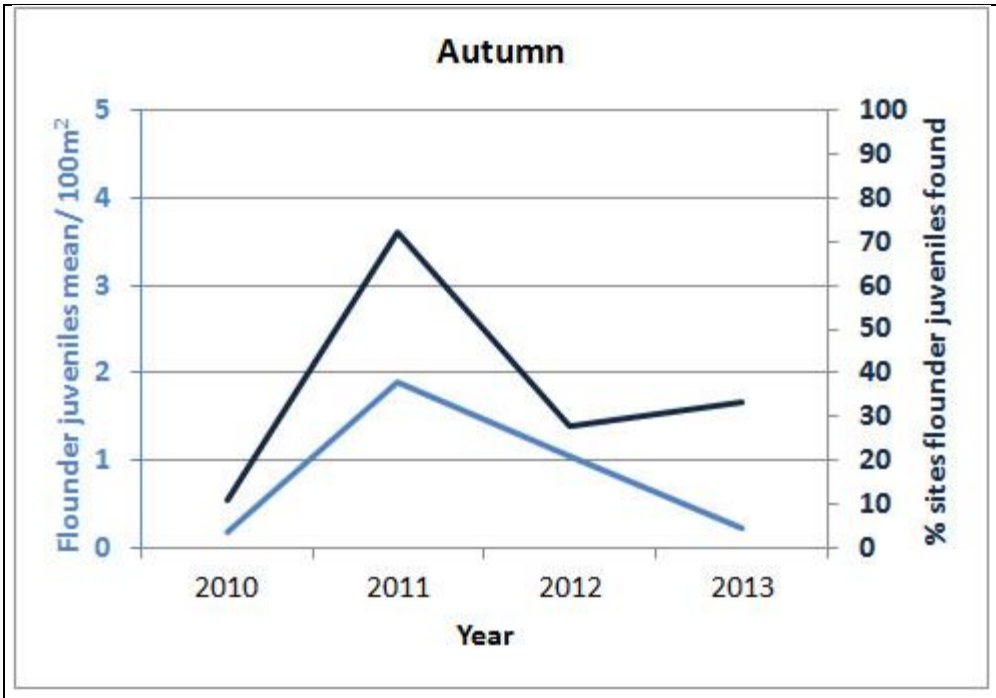

Figure 2. Flounder juveniles abundance and occurrence in the autumn. Mean of flounder juveniles in 100 square meters is presented in light blue lines. In calculation minimum haul area was used. Dark blue color describes the percent of sites where flounder juveniles were found. 18 sites visited every autumn are included.

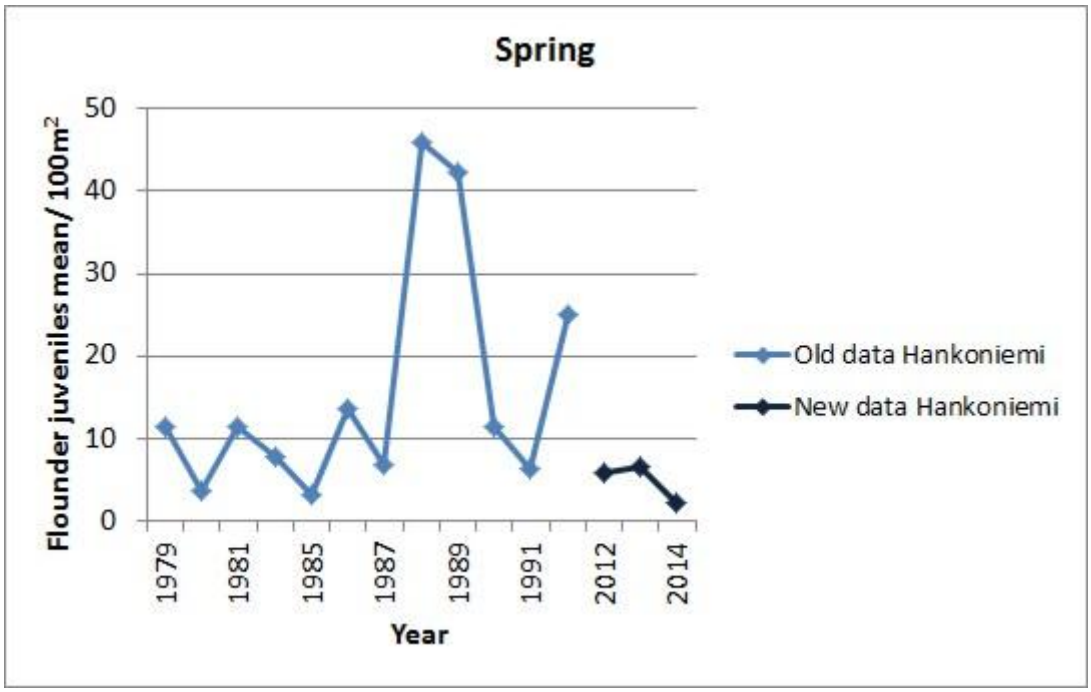

Figure 3. Comparison of old and new data. Flounder juveniles mean per 100 square meters in the spring. Old data is from years 1979 to 1992 (no data from years 1982 and 1984) and new data from years 2012 to 2014.

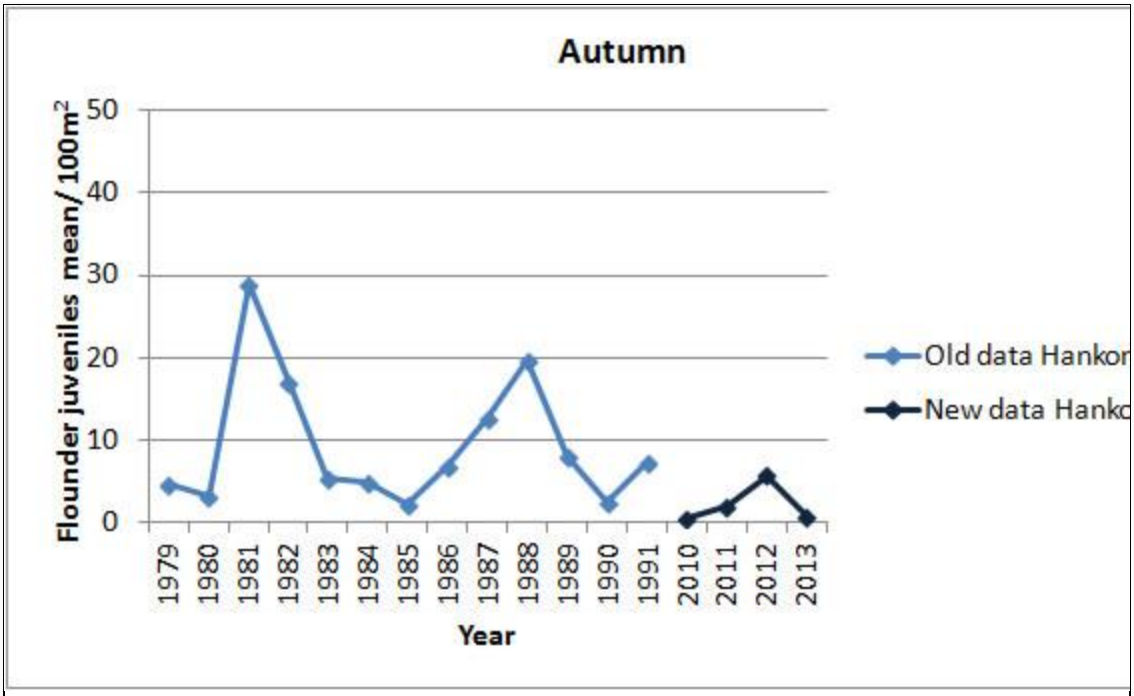

Figure 4. Comparison of old and new data. Flounder juveniles mean per 100 square meters in the autumn. Old data is from years 1979 to 1991 and new data from years 2010 to 2013.